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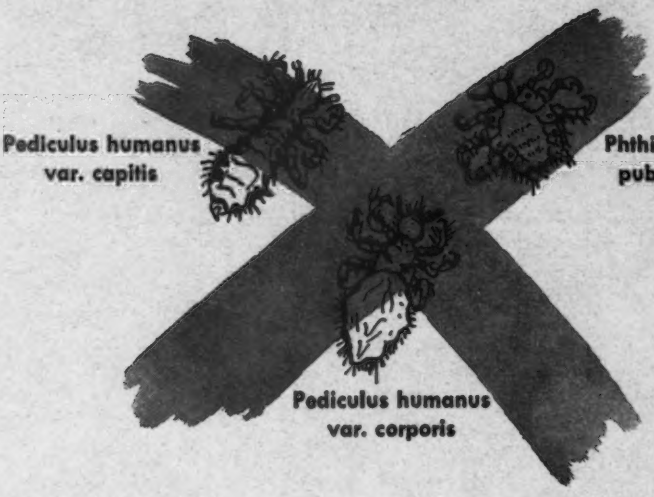

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VOLUME 45 TORONTO, SEPTEMBER 1954 NUMBER 9

Organization and Financing of Personal Health Services Today

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I. Perspective

AFTER 15 to 20 years of experience with various types of health insurance plans in the United States and Canada, it is well for us to take stock to see how we got here, where we are, and where we might be going. Original objectives and hopes in any movement may be somewhat blurred after 15 to 20 years because of the pressing day-to-day problems faced by providers of service and busy administrators.

In view of my experiences, both in Canada and in the United States, I have been struck by the similarities in our health problems, and whatever general observations I make can apply to both sides of the border. The organization of our health and welfare services is in principle very similar, as are our respective economies.

As a backdrop to health insurance it is well to recall that in our modern industrial economy we are faced with five economic risks which jeopardize the continuity of a family's income. These risks are quite outside the control of individual families in that prudence and diligence are inadequate to cope with them. They are:

1. Unemployment because of lack of work.
2. Unemployment because of disability.
3. Old age—living too long.
4. Premature death—dying too young.
5. Costs of medical care.

Presented at the forty-second annual meeting of the Canadian Public Health Association, held in the Chateau Frontenac, Quebec, May 31–June 2, 1954.

Any time any of the above contingencies occur, family financial solvency is jeopardized in various degrees. It is also generally agreed that a family, on its own, could not meet these contingencies adequately without some kind of pooled fund from which all could draw when needed.

Thus our approach to personal health services—as distinguished from traditional public health—has been mainly one of insurance or finances, with relatively little emphasis on organization and provision of services. There have been hospital construction programs on both sides of the border, to be sure, but they were not necessarily planned in direct relation to an expanding voluntary health insurance coverage.

Coincidentally, in both countries, there have recently been completed national surveys of the distribution of costs of medical care among families and extent of health insurance. The Canadian survey went much more deeply into morbidity than the one in the United States, but together they provide some comparative data. I refer specifically to the Canadian Sickness Survey (1), prepared jointly by the Department of National Health and Welfare and the Dominion Bureau of Statistics, and to the National Family Survey of Medical Costs and Voluntary Health Insurance (2) released by the Health Information Foundation, the field work in charge of the National Opinion Research Center, University of Chicago.

II. The Contemporary Scene

Obviously and quite naturally, our present health insurance plans have been grafted to the present structure of health services. They are regarded chiefly as a financial mechanism between the providers and recipients of service, a family budgeting device, as it were.

Ostensibly, the only change from the conditions existing in the Thirties is source of payment. The simplicity of the principle, however, belies the complexities of application. A whole train of administrative problems follows in this one act of shifting source of payment from the patient to another agency, be it government, non-profit plans, or private insurance.

The most obvious objective of present-day health insurance, but one which is often overlooked, is to spread the cost of personal health services over a large group. Many believe that the chief purpose is to raise the health level of the population, certainly a worth-while objective, but one which can confuse the issue. At the present stage of development I would assume the former to be a more demonstrable objective until such time as we incorporate more preventive services in our health insurance plans.

There is a lingering feeling that health insurance is designed for the low-income groups, however defined. A review of American and Canadian experience would indicate that it is the upper two-thirds of the income groups which avail themselves of health insurance, following closely the middle-class attributes of prudence and foresight along with fire insurance, automobile liability insurance and life insurance. This was not originally true in Europe and Great Britain, where health insurance was regarded mainly as a low-income problem.

As part of the problem of spreading the cost, it is assumed by many that the

chief problems are hospital care and in-patient physicians' services because they presumably represent sudden and high costs, and other services can be carried out-of-pocket without the intervention of an insurance agency. I gather this thinking is more characteristic of the United States than Canada because medical plans in Canada sponsored by medical societies usually provide home and office calls and out-patient diagnostic services, as well. The apparent success of Canadian medical plans is met with some incredulity on the other side of the border because they remain solvent even though the fee-for-service method of paying physicians is retained, a method of payment which is reputedly difficult to administer. The usual explanation is that Canadian physicians are different from American physicians.

It would appear that the broader the range of physicians' services offered through health insurance, the more it is likely to make inroads on some standard public health functions such as maternal and child health, immunizations, and others. It is interesting to observe that so-called curative medicine, as it expands, enters increasingly into the realm of prevention. This trend has great implications for standard public health programs, and I am not sure that public health people are completely aware of it. Prevention is now much more complex than 50 years ago.

As more and more services are added to a health insurance mechanism, the classical concepts of "insurability" and "uninsurability" become increasingly meaningless. There is a shift from an insurance concept to a budgeting and health service concept. Analogies between fire and automobile insurance on one side and health insurance on the other are difficult to reconcile and tend to retard effective thinking in the development of health insurance.

Even if we regard health insurance simply as a financial mechanism to spread the cost of personal health services, it is interesting to examine in detail the financial impact of services that are usually not covered. In the United States survey, for example, we found that the annual costs of physicians' services, exclusive of surgery and obstetrics, were just as unevenly distributed as hospital costs, and much more so than surgery. Dental care and drugs also revealed an extremely uneven distribution, indicating that multiples of small costs can add up to fairly large costs for some families in the course of a year. I, of course, have no illusions about the problems of providing for costs of drugs, appliances, dentistry, and other services usually not covered, or, for that matter, providing hospital and medical services in such a manner that utilization and with it, costs, do not rise unduly. It is necessary to spell out in detail the elements of a comprehensive service program because each type of service has problems more or less peculiar to itself. Let us recall that all physicians' and hospital services account for only 60 per cent of the medical dollar.

This leads me to considerations of types of controls to assure some balance between money available and utilization of services. The usual direction has been up, with no real evaluation, so far, as to whether or not those costs and utilization are justified. Granted, standards are difficult to apply, and a hospital admission rate of 100 may be as adequate as one of 200. Deductibles, coinsurance, restrictions on services, and exclusions are the usual devices to control costs and utilization, but again, it would seem to me that these neces-

sary control methods are not fully tested beyond trial and error. Equitable controls on services are one of the most serious problems in health insurance today, and they get the least critical attention. So-called experiments in administration are really not experiments in the true sense at all, because of lack of before-and-after pictures and control factors, which are part and parcel of experimentation. It can certainly be demonstrated that deductibles and coinsurance can be effective in controlling utilization and cost, but at what point would they discourage necessary care?

Finally, it would appear to me that service benefits are pretty much the pattern among Blue Cross plans and medical society plans in Canada, and less so in the United States. Cash benefits are mainly characteristic of private insurance companies since they are unable to enter into a contractual relationship with hospitals and physicians. It is, of course, much easier for the subscriber to know what his insurance will cover in a service benefit, but proponents of cash benefits contend that such benefits are easier to administer and are more flexible in relation to individual needs and local conditions.

III. Observations and Conclusions

In both the United States and Canada the families who have some type of health insurance, as contrasted with those who have no insurance, are likely to have more money and live in urban areas. In Canada the break appeared between $1,500 a year and under and $1,500 to $3,000. In the United States the break appeared between $3,000 and under and $3,000 to $5,000. Obviously, if health insurance is to be aimed at low-income groups, however defined, more intensive work in this area is necessary. It was also not surprising to note that the higher the income, the greater was the family outlay for personal health services. I did find it a little startling to note that the Canadian family pays an average of $82 a year for services, and the American family $207. Obviously, these need adjustment in terms of actual services received.

I note that about 40 per cent of the Canadian general hospital bill is paid by insurance (including the provincial hospital plans of British Columbia and Saskatchewan), and in the United States around 50 per cent. It appears that a greater portion of the physicians' costs are paid by insurance in Canada than in the United States, reflecting the existence of more medical plans providing a relatively full range of physicians' services.

Data appearing in our survey which have not yet been released by the Canadian survey have great implications for health insurance generally. In the American survey it was found that families with insurance had 30 per cent greater hospital admissions than families without insurance. The admission rates in British Columbia and Saskatchewan are still higher, however.

Families with surgical insurance had almost twice the surgical rate of families without insurance. Furthermore, rates between income groups were quite constant. It was insurance which made the difference. These data call for further analysis.

Another fact which has great implications for health insurance is the finding in the American survey that on the average the total charges for out-of-pocket expenses, excluding insurance benefits, were much greater than for those

without insurance. Several factors are operating: increased utilization of uninsured services as well as insured services; probability of a more expensive type of hospital accommodation; and possibility of higher charges. The Canadian picture is very likely similar and would vary only in degree.

Obviously, health insurance is here to stay. Equally obvious, there will be continuing expansion both in terms of people covered and in terms of benefits. Critical study is needed constantly. It is apparent that already we are not necessarily thinking in strict insurance terms, but are moving in the direction of a health service with a stable financial base with due consideration to quality.

Any system of financing personal health services must bear three facets in mind: (1) Are family medical costs cushioned sufficiently? An analysis of the impact of present-day benefits on family finances is necessary. (2) Is a stable and adequate income provided for an enormous investment in health facilities and personnel? (3) Is the insurance agency administrative cost equitable?

Finally, as we observe health insurance developments on both sides of the border, it is apparent that there are a great many variations as to sponsorship, range of benefits, method of payment to hospitals and physicians, and many other items. Diversity in itself is regarded as a good thing because it is assumed that diversity in health insurance is equated with flexible adjustment to the many social and economic variations on this continent. Diversity is a good thing if it is not expressed only in terms of what is good or easy for a health insurance program to administer, but also what is good for the public.

Personal health services are unique in that it should be possible to work out minimum basic services to which everyone should have access, and below which no health insurance program should fall. Thus, the range of services provided in rural areas or urban areas, for low income or middle income, should be relatively the same because people's basic needs are relatively the same, although expressed demand varies considerably.

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Hospitalization Experience of a Government Hospital Care Insurance Plan

PART 1

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FOR a considerable number of years the problem of financing general hospital care for the community as a whole has received a great deal of study in Canada. Several types of insurance programs have been developed in different provinces for this purpose. British Columbia and Saskatchewan have government plans financed partly by personal taxes or premiums and partly by general provincial revenues. Alberta has its so-called "Dollar-a-Day" scheme whereby the patient, the municipality and the provincial government each pay a portion of most hospital bills. Newfoundland operates its cottage hospital program. Blue Cross Plans and life insurance companies also provide coverage of hospital bills for large segments of the population, especially in urban centres. It seems not unlikely that most of these programs which have grown up over the years will continue to develop along the lines of their existing patterns.

In Saskatchewan, the province with which this study is concerned, coverage of hospital bills for entire communities developed initially on a municipal basis, the first enabling legislation being passed by the Legislature in 1927. By 1946 two of the recently formed health regions were providing the cost of hospital care for the residents of all municipalities within their boundaries. All municipal and regional programs for in-patient hospital care were superseded by the province-wide coverage of the Saskatchewan Hospital Services Plan when it was established at the beginning of 1947.

In the six years following its inception a considerable amount of statistical information has been accumulated by the Plan regarding patterns of hospital utilization in a group of beneficiaries comprising most of the population of Saskatchewan. Information of this kind may be useful in the development of other hospital care insurance plans which cover the majority of people in a province or region. With this thought in mind, the present study of hospitalization experience among beneficiaries of the Saskatchewan Hospital Services Plan in the six years 1947 to 1952 has been undertaken.

Presented before the Vital and Health Statistics Section at the forty-first annual meeting of the Canadian Public Health Association, held in the Royal York Hotel, Toronto, October 1 and 2, 1953.

Covered Population

All persons who have resided in Saskatchewan for more than six months, and who are not already provided with hospital services under other government programs, may become beneficiaries of the Plan. The average number of beneficiaries has ranged from 766,304 in 1949 to 786,497 in 1952.

An individual's status as a beneficiary, and resulting coverage of hospital bills, is contingent upon prior payment of a personal hospitalization tax. The personal tax is required to be paid by all residents of the southern half of the province who are not in excluded groups, and may be paid voluntarily, in order to obtain coverage of hospital bills, by persons residing in the sparsely settled far northern areas. Social assistance groups become beneficiaries as a result of tax payment by provincial or municipal governments. Newborn infants, whose mothers are beneficiaries, receive coverage by the Plan without additional tax payment. A high level of tax collections during the past six years, representing approximately 97 per cent of the estimated maximum, has resulted in the services of the Plan being made available to most of the population of the province. Throughout its six years of operations, as seen in Table 1,

TABLE 1

Covered Population Compared with Federal Census and Inter-censal Estimates, 1947–1952

Year	Federal Census of Saskatchewan	Covered Population	
		Number of Beneficiaries	Per cent of Census
1947	836,000*	780,445	93.4
1948	838,000*	776,478	92.7
1949	832,000*	766,304	92.1
1950	833,000*	766,785	92.1
1951	831,728	779,470	93.7
1952	843,000*	786,497	93.3

*Intercensal estimates, D.B.S. Reference Paper No. 40, February, 1953.

beneficiaries of the Plan have represented between 92.1 per cent and 93.7 per cent of the total population of Saskatchewan.

Groups not covered by the Plan's operations include patients in tuberculosis sanatoria and mental hospitals, inmates of gaols and penitentiaries, members of the Armed Forces and R.C.M.P., and recipients of War Veterans Allowance, all of whom receive hospital care under other government programs. Treaty Indians on reserves are also outside the scope of the Plan's operations. After residing away from the reserve for a period of eighteen months, however, an Indian may become a beneficiary through voluntary payment of the hospitalization tax.

Because the Plan covers so large a proportion of the population, the age and sex distribution of its beneficiaries is very similar to that of the total population of Saskatchewan as recorded in the Federal census. The percentage distribution of 1952 beneficiaries by age and sex is compared in Table 2 with a

TABLE 2

PERCENTAGE DISTRIBUTION BY AGE AND SEX OF BENEFICIARIES, 1952*, AND OF THE FEDERAL CENSUS OF SASKATCHEWAN, 1951

Item	All Ages	Age in Years						
		0–4	5–14	15–24	25–44	45–64	65–69	70+
Both Sexes								
S.H.S.P. Beneficiaries, 1952	100.0	11.9	18.7	15.2	27.5	18.2	3.6	4.9
Census, 1951	100.0	12.0	18.7	15.8	27.6	17.8	3.5	4.6
Male								
S.H.S.P. Beneficiaries, 1952	100.0	11.8	18.4	14.6	26.7	19.1	4.1	5.3
Census, 1951	100.0	11.7	18.3	15.2	27.0	18.8	4.0	5.0
Female								
S.H.S.P. Beneficiaries, 1952	100.0	12.0	19.0	16.0	28.5	17.1	3.0	4.4
Census, 1951	100.0	12.4	19.1	16.4	28.4	16.7	2.9	4.1

*Annual Report of the Saskatchewan Hospital Services Plan, 1952.

similar distribution of the total population of the province according to the 1951 census. The fact that differences between the two groups are so slight lends support to the claim that there is little evidence of selection by age or sex among the beneficiaries of the Plan.

VOLUME OF HOSPITAL CARE

What amount of hospital care should one expect to see provided in a province in which most of the population is covered by a hospital care insurance plan? The report of the Saskatchewan Health Survey Committee, published in 1951 (1), indicated that the needs of the province under these conditions should be met by 7.5 public general hospital beds per 1,000 people. This estimate, based on an average occupancy of 80 per cent of the rated bed capacity of hospitals, would provide 2,190 days of care annually per 1,000 people. With an average hospital stay of 10.5 days, which is the Plan's actual experience during the past six years, an annual volume of cases at a rate of 209 per 1,000 people would therefore be expected. These rates are not greatly different from the actual experience of the Plan during the past three years.

The volume of hospital cases (other than newborns) among the Plan's beneficiaries increased rapidly from 121,951 cases in 1947 to 152,957 in 1949, as seen in Table 3, and then reached a plateau, the years 1950 to 1952 witnessing relatively small fluctuations. The days of care, on the other hand, increased every year until 1951 and then declined slightly in 1952. These fluctuations are partly explained by the fact that statistics in Table 3 are based on discharged cases, i.e., a few cases with stays of a year or more have been discharged each year, and their accumulated days of stay have swelled the total in the year of discharge. Variations in the number of such long-stay cases discharged each year have thus contributed to fluctuations in the mean length of stay. As seen in Table 3, this has ranged from 10 days to 11.1 days. The median stay has been seven days in each of the six years 1947 to 1952.

TABLE 3
VOLUME OF HOSPITAL CARE COVERED BY SASKATCHEWAN HOSPITAL SERVICES PLAN, 1947–1952

Year	Adults and Children				Newborns		
	Discharged Hospital Cases	Days of Care	Average Days of Stay		Discharged Hospital Cases	Days of Care	Average Days of Stay
			Mean	Median			
1947	121,951	1,221,453	10.0	7	20,415	187,092	9.2
1948	138,030	1,455,744	10.5	7	19,164	173,743	9.1
1949	152,957	1,569,581	10.3	7	19,402	171,356	8.8
1950	155,951	1,684,721	10.8	7	19,201	169,563	8.8
1951	154,848	1,715,232	11.1	7	19,729	169,062	8.6
1952	161,499	1,710,689	10.6	7	20,742	170,188	8.2

With only minor changes from year to year in the total covered population, hospitalization rates per 1,000 beneficiaries have followed a curve similar to that of the total volume of hospital care. The case rate increased from 156 per 1,000 beneficiaries in 1947 to 200 per 1,000 in 1949, and the rates in subsequent years ranged from 199 to 205 cases per 1,000. Days of care per 1,000 beneficiaries increased from 1,565 days in 1947 to 2,201 days in 1951 and dropped to 2,175 in 1952. As might be expected, considering the relatively stable covered population, adjustments to these rates which are made in Table 4, to allow for year-to-year variations in the age and sex distribution

TABLE 4
HOSPITALIZATION RATES PER 1,000 BENEFICIARIES, 1947–1952

Year	Discharged Hospital Cases		Days of Care	
	Crude Rate	Adjusted Rate*	Crude Rate	Adjusted Rate*
1947	156	157	1,565	1,607
1948	178	179	1,875	1,894
1949	200	200	2,048	2,061
1950	203	203	2,197	2,197
1951	199	—	2,201	—
1952	205	205	2,175	2,172

*Adjusted for variations in age and sex distribution by the direct method, using 1951 beneficiaries as a standard population.

of the population at risk, make very little difference in the trend displayed in that table.

About 95 per cent of all births in Saskatchewan take place in hospital at the present time, and the Plan covers the vast majority of such cases. Newborn hospital accounts covered by the Plan have ranged from 19,164 in 1948 to a maximum of 20,742 in 1952. Similar to experience elsewhere, the average stay in hospital for newborns has declined during the past six years, dropping from 9.2 days in 1947 to 8.2 days in 1952.

Most of the cases covered by the Plan are cared for in Saskatchewan hospitals; beneficiaries receiving hospital care outside the province have averaged little more than three per cent of total cases in the six years 1947 to 1952.

Within the boundaries of the province the Plan's beneficiaries comprise approximately 90 per cent of all patients in public general hospitals (Table 5).

TABLE 5

CASES COVERED BY S.H.S.P.* IN SASKATCHEWAN HOSPITALS AND OUT-OF-PROVINCE INSTITUTIONS, 1947–1952

Year	Discharged Cases Covered by S.H.S.P.			Admissions to Sask. Hospitals**	
	Total	Outside Sask.	Within Sask.†	Number	Percentage Represented by S.H.S.P. Discharges
1947	121,951	4,734	117,217	130,700	89.7
1948	138,030	5,967	132,063	145,378	90.8
1949	152,957	5,249	147,708	162,785	90.7
1950	155,951	4,320	151,631	167,928	90.3
1951	154,848	4,749	150,099	164,184	91.4
1952	161,499	5,135	156,364	172,743‡	90.5

*Excluding newborns.

**Excluding admissions to mental hospitals, tuberculosis sanatoria and Federal government institutions.

†Includes admissions of beneficiaries to D.V.A. and Indian hospitals and a few non-tuberculous cases treated in tuberculosis sanatoria, representing less than one-quarter of one per cent of the total in each year.

‡Preliminary figure.

Slightly more than this proportion of patient days, or about 92 per cent, is covered by the Plan in such hospitals. This difference, as suggested by the data in Table 2, is due mainly to the fact that the principal excluded groups in the population who use general hospitals, such as persons with less than six months' residence in the province, contain a smaller proportion of elderly people. As will be seen later, elderly people generally require longer than average periods of care when hospitalized.

While the total volume of the Plan's hospital cases has increased considerably, only slight variations have occurred during the past six years in the distribution of cases according to length of stay. As indicated in Table 6,

TABLE 6

LENGTH OF STAY OF DISCHARGED HOSPITAL CASES, 1947–1952

Length of Stay in Days	1947	1948	1949	1950	1951	1952
	Number of Cases					
Total	121,951	138,030	152,957	155,951	154,848	161,499
1–5	48,364	55,983	65,242	64,247	61,955	67,570
6–10	39,697	43,531	47,720	49,675	50,423	52,485
11–20	21,679	23,548	24,056	25,159	26,701	25,864
21–30	6,302	7,555	8,014	8,249	7,510	7,551
31–60	4,392	5,317	5,649	6,128	5,790	5,668
61+	1,517	2,096	2,276	2,493	2,469	2,361
	Percentage Distribution					
Total	100.0	100.0	100.0	100.0	100.0	100.0
1–5	39.7	40.6	42.6	41.2	40.0	41.8
6–10	32.5	31.5	31.2	31.9	32.6	32.5
11–20	17.8	17.0	15.8	16.1	17.2	16.0
21–30	5.2	5.5	5.2	5.3	4.9	4.7
31–60	3.6	3.9	3.7	3.9	3.7	3.5
61+	1.2	1.5	1.5	1.6	1.6	1.5

cases of one to five days have ranged from 39.7 per cent of the total in 1947 to a maximum of 42.6 per cent in 1949; cases of six to ten days have represented between 31.2 per cent and 32.6 per cent of the total; and variations in other groups have been similarly small.

Age and Sex Incidence

When the volume of hospital cases is examined on the basis of the different age groups in the covered population, the most noticeable feature is that the youngest and the oldest groups experience the highest hospitalization rates.

TABLE 7
Discharged Hospital Cases per 1,000 Beneficiaries by Sex and Age, 1947–1952

Sex and Age	1947	1948	1949	1950	1951	1952
Both Sexes	156	178	200	203	199	205
Male	113	135	156	159	153	159
0–1	224	274	379	366	310	331
1–4	119	152	183	184	170	175
5–14	99	118	146	142	130	139
15–24	94	109	117	124	115	122
25–44	81	97	107	108	103	107
45–64	124	140	165	164	164	166
65–69	182	215	240	250	260	251
70+	266	302	328	352	382	392
Female	203	225	247	252	247	255
0–1	166	209	269	279	230	251
1–4	97	122	148	147	144	145
5–14	99	116	143	140	126	134
15–24	258	266	282	291	291	302
25–44	288	307	327	327	326	332
45–64	170	205	225	232	227	239
65–69	201	242	260	281	287	285
70+	241	286	311	345	376	387

Source: Annual Reports of the Saskatchewan Hospital Services Plan, 1947–1952.

As will be observed in Table 7, rates for the age group 0–1 have ranged from 224 cases for males and 166 for females per 1,000 beneficiaries in 1947 to peaks of 379 cases for males in 1949 and 279 cases for females in 1950. Among beneficiaries of 70 years and upwards the incidence of hospitalization has been similarly high and each succeeding year has witnessed a rise in the rate, which reached 392 cases per 1,000 for males and 387 for females in 1952.

Male beneficiaries after the first year of life experience relatively low hospitalization rates until the onset of middle age. After the age of 45 years the incidence of hospitalization climbs rapidly.

Female rates up to the age of 15 years are somewhat lower than for males of the same age. At that age the number of hospital cases per 1,000 beneficiaries rises sharply above the male rate due to the fact that the majority of maternity cases are cared for in hospital. The incidence of hospitalization then does not drop below the male rate until the age group 70 years and over.

Average length of stay among hospitalized beneficiaries drops slightly after the first year of life and remains at a relatively low level until the approach of middle age, when each succeeding age group experiences a longer average stay. For females in the age groups 0–1 and 70 years and over, average stay is somewhat longer than for males, while at other ages the reverse tends to be the case. The average days of stay among beneficiaries during the six years 1947 to 1952 is summarized according to sex and age in Table 8.

TABLE 8

AVERAGE DAYS OF STAY BY SEX AND AGE, 1947–1952

Sex and Age	1947	1948	1949	1950	1951	1952
Both Sexes	10.0	10.5	10.3	10.8	11.1	10.6
Male	10.7	11.3	11.0	11.6	12.2	11.5
0–1	9.0	9.3	9.3	8.9	8.6	8.8
1–4	6.1	6.0	6.3	6.9	6.7	6.7
5–14	5.9	5.6	5.7	6.4	6.8	6.9
15–24	8.0	8.3	7.9	8.2	8.3	7.9
25–44	9.0	9.4	9.2	9.3	9.3	9.0
45–64	13.6	14.5	14.2	14.4	14.4	13.7
65–69	17.4	18.6	18.5	18.3	19.5	18.2
70+	19.8	21.6	21.2	22.7	24.1	21.8
Female	9.6	10.0	9.7	10.3	10.3	10.0
0–1	9.3	9.5	8.7	9.2	9.1	8.9
1–4	6.2	6.1	6.0	6.6	6.4	6.2
5–14	5.5	5.7	5.4	6.0	6.6	6.5
15–24	7.7	7.8	7.4	7.5	7.5	7.3
25–44	9.0	9.1	8.8	8.8	8.7	8.4
45–64	13.7	14.2	14.0	14.4	14.0	13.8
65–69	16.8	18.2	17.4	18.1	17.4	17.9
70+	20.3	21.3	22.0	24.3	24.9	22.0

Source: Annual Reports of the Saskatchewan Hospital Services Plan, 1947–1952.

MORBIDITY EXPERIENCE

Perhaps one might expect that at the beginning of a province-wide hospital care insurance program there would be a backlog of elective admissions which had not previously received hospital care because of the financial barrier, and that this backlog would be taken care of in the first few years of operation. Morbidity statistics presented in Table 9 do not provide any clear-cut evidence that this was the case with the Saskatchewan Hospital Services Plan. Hernia of the abdominal cavity, for example, might be considered in this category; yet the trend of hospitalization for treatment of this condition has shown little change in the past six years. Possibly the prior existence of a large number of municipal and regional hospital and medical care programs, as well as a high level of employment and of agricultural income for some years preceding the introduction of the Plan, had some influence in producing the pattern of hospital care displayed in Table 9.

TABLE 9

CASES PER 1,000 BENEFICIARIES BY DIAGNOSIS, 1947–1952
(AGE-SEX-ADJUSTED RATES*)

List No.†	Primary Diagnosis	Cases per 1,000					
		1947	1948	1949	1950	1951	1952
	All Causes	157.29	178.55	200.03	203.37	198.66	205.47
C43	Deliveries, Complications of Pregnancy, Childbirth and the Puerperium	33.13	32.29	33.79	34.30	35.19	36.66
C29	Acute Pharyngitis and Tonsilitis and Hypertrophy of Tonsils and Adenoids	15.64	18.42	20.95	19.96	15.90	15.50
BN47-50	Accidents, Poisonings, and Violence	11.98	13.04	15.03	16.62	16.08	16.87
C36	Appendicitis	9.34	9.79	8.97	8.86	7.80	7.57
C42	Diseases of Genital Organs	7.23	8.02	8.37	8.22	8.24	8.56
C44	Boil, Abscess, Cellulitis and Other Skin Infections	4.35	4.43	3.44	2.72	2.28	2.14
C31	Pneumonia	4.21	5.43	7.45	8.93	9.26	8.65
C12	Malignant Neoplasms, Including Neoplasms of Lymphatic and Haematopoietic Tissues	4.01	4.56	4.50	4.50	4.18	4.16
C39	Diseases of Gallbladder and Bile Ducts	3.48	3.91	4.42	4.75	4.36	4.54
C13	Benign Neoplasms and Neoplasms of Unspecified Nature	2.93	3.37	3.51	3.66	4.23	4.57
C27	Diseases of Veins	2.91	3.39	3.49	3.38	3.12	3.47
C35	Diseases of Stomach and Duodenum, except Cancer	2.70	3.51	4.02	4.21	4.18	4.01
C46	Arthritis and Rheumatism, except Rheumatic Fever	2.69	3.30	3.88	4.48	4.44	4.23
C38	Diarrhoea and Enteritis	2.69	3.51	3.64	3.81	3.52	4.13
C30	Influenza	2.68	3.34	7.04	6.78	7.41	6.11
C25	Arteriosclerotic and Degenerative Heart Disease	2.56	3.19	3.37	4.02	4.31	4.51
C37	Hernia of Abdominal Cavity	2.47	2.58	2.63	2.33	2.56	2.84
C32	Bronchitis	1.76	2.97	3.81	4.00	4.11	4.82
C16	Diabetes Mellitus	1.76	2.23	2.25	2.57	2.09	2.46
C47	Diseases of Bones and Other Organs of Movement	1.75	1.75	2.04	2.48	2.66	2.89
C21	Diseases of Eye	1.54	1.81	1.91	1.79	1.82	1.87
C22	Diseases of Ear and Mastoid Process	1.45	2.06	3.59	3.89	3.00	3.20
C19	Psychoneuroses and Psychoses	1.37	1.65	1.66	1.83	1.96	2.04
C14	Allergic Disorders	1.34	1.78	2.09	2.28	2.50	2.60
C15	Diseases of Thyroid Gland	1.31	1.40	1.55	1.23	1.24	1.22
C48	Congenital Malformations and Diseases Peculiar to Early Infancy	1.16	1.28	1.59	1.51	1.58	1.49
C26	Hypertensive Disease	1.14	1.44	1.77	1.93	2.13	2.08
C20	Vascular Lesions Affecting Central Nervous System	1.10	1.23	1.23	1.42	1.55	1.52
C41	Nephritis and Nephrosis	.74	.91	.99	.86	.74	.68
C18	Anaemias	.63	.64	.75	.87	.77	.87
	All Others	25.24	31.32	36.30	35.18	35.45	39.21

*Adjusted by the direct method, using 1951 beneficiaries as a standard population.
†Classified according to "International Statistical Classification of Diseases, Injuries, and Cause of Death, 1948", Vol. 1, pp. 362–364.

Provision of maternity care heads the list of reasons for hospitalization among the Plan's beneficiaries. The hospitalization rate for this purpose, on an age-sex-adjusted basis, has increased more than 10 per cent between 1947 and 1952. The principal reason for this has been the rise in the proportion of Saskatchewan births occurring in hospital, from 86.7 per cent in 1946 to the present level of approximately 95 per cent. This rise has occurred to a much greater extent in small urban centres and rural areas than in cities (2). As a trend of this nature has been evident for some years in most parts of this continent, it is to be expected that some increase in the proportion of Saskatchewan births in hospital would take place. On the other hand, provinces with

tax-supported programs for hospital care of maternity cases experience the highest percentage of births in hospital (3). This fact suggests that the operation of the Plan has been partly responsible for the increase in Saskatchewan.

Cases diagnosed as acute pharyngitis and tonsillitis, and hypertrophy of tonsils and adenoids, were the second most frequent type covered by the Plan upon admission to hospital from 1947 to 1950. The volume of such cases has tapered off during the past two years and this change is thought to be connected with the deferment of tonsillectomies and adenoidectomies during the polio seasons of 1951 and 1952.

Accidents, poisonings and violence ranked third as a cause of admission until 1951, when it moved to second place. Every year except 1951 has witnessed an increase in the hospitalization rate in this diagnostic class. This trend parallels the annually increasing toll of highway accidents, of which Saskatchewan has had its share.

Appendicitis, which was the fourth ranking cause of hospitalization in 1947 with a rate of 9.34 cases per 1,000 beneficiaries, dropped to sixth place with a rate of 7.57 cases per 1,000 by 1952. It would be of great value to know if the decline in the incidence of hospitalization for care of this disease is the result of the increased use of antibiotics during the past few years.

The widespread use of antibiotics may be responsible for the drop in the number of cases with a diagnosis of boil, abscess, cellulitis and other skin infections. Hospitalization rates for pneumonia, influenza and bronchitis have more than doubled during the past six years. Rates for most other causes of admission to hospital have not changed markedly since 1949.

Part 2 will appear in the October issue. Reprints of the complete article will be available from the author or the Association after the publication of the second part.

Observations on the Applied Epidemiology of Gonorrhoea

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DURING the past decade, British Columbia, in common with most other health jurisdictions in North America, has made substantial gains in reducing morbidity from venereal disease. By far the greatest successes have been achieved since 1946, when the Province entered the post-war era with the biggest venereal disease problem in Canada. Thus reported cases of infectious syphilis have fallen from 834 cases in that year to 26 cases in 1953—a reduction of 97 per cent.

In so far as the control of gonorrhoea is concerned, the advances have been much less spectacular. From a total of 4,618 cases reported in 1946, the figure has declined to 2,968 cases in 1953, which represents only a 36 per cent decrease over the same period (Table I).

It is apparent therefore that such successes as have been achieved for gonorrhoea are in no way comparable to those attained against infectious syphilis. With approximately 3,000 cases reported per year, gonorrhoea must now be considered the major problem facing our control organization. The relative magnitude of this problem is evident if we consider that in 1953, gonorrhoea ranked fourth in morbidity among reportable communicable diseases in British Columbia whilst 114 cases of gonorrhoea were reported for each case of primary or secondary syphilis. From these figures, it is difficult to escape the conclusion that if further advances are to be made in the control of this common infection, there will have to be a reorientation of the objectives and activities of the control organization and a sincere attempt made to devise new approaches and answers to those apparently refractory problems which have hindered our efforts thus far.

In this connection, it may perhaps be of interest to review critically our past and present thinking regarding the epidemiology of gonorrhoea (and indeed, of all venereal disease) as a preliminary to studying some new avenues of attack which might yield the desired result. It is recognized as axiomatic that gonorrhoea is transmitted solely between human beings, without the aid of intermediate hosts or vectors, so that the search for new cases of infection can be limited to the sexual contacts of the original case. The optimistic hope

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TABLE I

NEW NOTIFICATIONS OF VENEREAL INFECTION AND RATE PER 100,000 POPULATION, PROVINCE OF BRITISH COLUMBIA, 1944–1953

Year	Total Venereal Disease		Gonorrhoea			Infectious Syphilis		
	Number	Rate	Number	Rate	Per cent of total	Number	Rate	Per cent of total
1944	4,737	508.3	3,358	360.3	70.9	380	40.8	8.1
1945	5,245	552.7	3,711	391.0	70.8	645	68.0	12.3
1946	6,790	677.0	4,618	460.4	68.0	834	83.2	12.3
1947	5,999	574.6	4,056	388.6	67.6	575	55.1	9.6
1948	4,534	419.0	3,608	333.5	79.6	239	22.1	5.3
1949	4,524	406.1	3,694	331.6	81.6	139	12.5	3.1
1950	4,289	377.2	3,627	319.0	84.6	61	5.4	1.4
1951	3,916	336.1	3,336	286.4	85.2	36	3.1	0.9
1952	3,914	326.7	3,098	258.6	79.1	33	2.7	0.8
1953	4,164	338.5	2,968	241.3	71.3	26	2.1	0.6

Source: Form N.H.1.

which prevailed a few years ago that penicillin therapy was so highly specific for gonococcal infection that it was sufficient to treat only the known case and rely upon the contacts to seek medical care with the onset of symptoms but without organized contact-tracing on our part, completely ignored this simple epidemiologic principle. The inevitable result was that many infected contacts remained free to continue their disease-dispensing activities. By contrast, the epidemiologic approach, and contact-tracing effort in particular, was pushed to the utmost against syphilis, the more serious disease.

Time, and the relative failure of our efforts to bring gonorrhoea under control, have brought with them the realization that therapy alone (even with all the manifold advantages of penicillin) is not the answer to this problem. Inevitably they have led to a re-examination of the epidemiologic concept outlined above, with attempts to devise rational control measures based upon applied epidemiology.

In British Columbia, we have long suspected that there was a hard core of patients which was responsible for disseminating and maintaining the reservoir of infection in the Province. In order to ascertain the dimensions of this suspect group, certain detailed studies were carried out with a view to investigating both the personality and those habits of a repeater-patient which might make him more accessible to revitalized epidemiology.

The most detailed study, and the one which will be more generally referred to in this paper, was a study of all repeater-patients undertaken in the Division of V.D. Control during a one-year period (May 1, 1951 to April 30, 1952). During this period, 3,763 notifications of venereal disease from all over the Province were scrutinized, and those notifications reporting on an individual previously known to us were studied in detail. From this study we defined a repeater as "an individual whose last venereal infection was within the 12 months previous to the year under study, who acquired a repeat infection

during the study." A control group comprised all notifications for the Province during the calendar year of 1951.*

Since it was subsequently found (Figure 1) that 66 per cent of notified repeaters during the study year, and 45.5 per cent of all notifications during the control year, referred to patients attending the Vancouver Clinic where

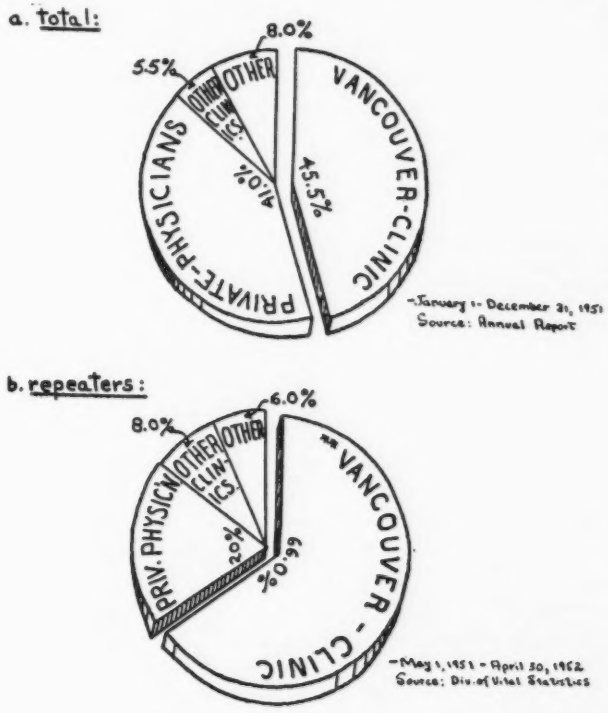

FIG. 1

SOURCE OF REPORTING OF V.D. NOTIFICATIONS,* 1951

*To the Division of V.D. Control, Province of British Columbia.
**Includes Vancouver City Gaol—a total of 6% of all repeaters.

they were available for more detailed study, further investigation was undertaken upon all patients who attended this clinic and acquired a repeat infection between February 1, 1953 and July 31, 1953. In all, 52 males and 35 females were studied. This group was given a detailed work-up comprising a sociological interview by an experienced social worker attached to the Division, and a psychometric test, the Bell Adjustment Inventory. The case-work interview was supplemented by additional material provided by other social-work

*It should be noted that the time intervals of the control and study groups do not correspond. This was due to the fact that processing of data concerning repeater patients on to punch cards was not undertaken until May 1, 1951.

agencies in the community. For administrative reasons, the greater part of the work done on females was undertaken by an experienced epidemiological worker attached to the Vancouver City Gaol female examination centre.

While the bulk of the material accumulated is primarily of sociological interest, and will form the basis of a future report from this Division, a substantial part of the information obtained has proved to be of considerable help in rationalizing and developing a modification of our epidemiological program.

Of the 3,763 cases of venereal disease reported for the entire Province in the year under study, it was found that 400 cases were really repeat infections by individuals already known to the Division during that year. In other words, only 3,363 individuals had actually experienced 3,763 infections. A detailed breakdown of these notifications is given in Table II.

TABLE II

REPEATER STUDY, PROVINCE OF BRITISH COLUMBIA

Jan. '51 — Dec. '51

Total notifications 3,916

Study notifications 3,763

May '51 — Apr. '52

Total	Male	Female	Ratio M/F
3,916	2,843	1,073	2.64

	Total	Male	Female	Ratio M/F
Notifications	3,763	2,729	1,034	2.63
Patients	3,363			
Non-repeaters	2,338			
Repeaters	1,025	650	375	1.73
Group A*	658	395	263	1.50
Group B†	367	255	112	2.27

*Patients known to have had a previous infection within the year prior to May 1, 1951.
†Patients known to be repeaters but not known to have had a previous infection within the year prior to May 1, 1951.

From this table it can be seen that the whole repeater group (1,025 patients) makes up about one-third of the total case-load. Of this group, however, about two-thirds (658 patients to be exact) acquired a second infection within one year. This was the reason for our definition of a repeater patient, and we believe that these figures demonstrate the dimensions of the hard-core problem in venereal disease control. The fact that one patient in every three is so little influenced by his previous disease experience that he acquires a second infection, often in short order, should certainly shake us out of our complacency that control programs, as presently organized, are adequately or realistically meeting the challenge of the chronic repeater.

Again, in studying the trend of male:female notifications over the years,

it was found that the ratio in British Columbia ran consistently between 2.00 and 2.64, the summary experience over the past ten years being a ratio of 2.38 (Table III). For the record, the ratio of male to female notifications of venereal disease for the control calendar year 1951 was 2.64 and that for the study year 2.63.

TABLE III

NEW NOTIFICATIONS OF VENEREAL DISEASE
PROVINCE OF BRITISH COLUMBIA
1944–1953

Year	Total	Male	Female	Ratio M/F
1944	4,737	3,388	1,349	2.51
1945	5,245	3,769	1,476	2.55
1946	6,790	4,825	1,965	2.45
1947	5,999	4,278	1,721	2.48
1948	4,534	3,147	1,387	2.26
1949	4,524	3,019	1,505	2.00
1950	4,289	2,860	1,429	2.00
1951	3,916	2,843	1,073	2.64
1952	3,914	2,808	1,106	2.53
1953	4,164	2,926	1,238	2.38
Total	48,112	33,863	14,249	2.38

Source: Form N.H.1.

This sex differential suggests that—

(a) the males are unwilling to discuss their sexual partners, who, in consequence, are never brought to treatment, or

(b) if the statistics are to be taken at their face value, a relatively small group of females is infecting a large group of males, or

(c) a combination of the above factors is operating.

Perhaps some clue to the answer will be arrived at if we study our repeater group. Reference again to Table II shows that the male:female ratio for the entire repeater group has fallen to 1.73, and for the most promiscuous group, to 1.50, a ratio closer to that which would be expected, for under theoretical circumstances one male infects one female or vice versa; therefore the male: female ratio should approximate unity, provided always that our epidemiological service is so efficient as to apprehend the source before he or she has infected more than one contact.

It should also be noted that the small difference between the male:female ratio of group B repeaters and the total experience over the past ten years at the Division probably occurred as a result of chance alone; on the other hand, the great difference in ratio shown by group A repeaters is of statistical significance.

It is interesting to speculate upon the reasons for this change in sex differential for repeater patients. We may suspect the following:

(a) The male repeater may be more willing to talk about his sex partners than his non-repeater counterpart, and thus case-finding by clinic epidemiologists amongst his female contacts is more successful.

(b) The promiscuous female may be more willing to seek treatment voluntarily than her less promiscuous counterpart, if she suspects an infective exposure.

(c) The female who acquires a venereal infection may be more prone to a repeat infection than her male companion.

We do not feel that we are in a position to give a categorical answer as to which factor or factors amongst those outlined above are responsible for the alteration in the sex differential. However, we are inclined to believe that the verbosity of the male repeater is not an important factor, for while we found that 71.3 per cent of information about the female contact was adequate for investigation when supplied by males, it was still insufficient in 25.4 per cent of cases to locate the offending female. On the contrary, 87.3 per cent of information about the male contact was adequate when supplied by repeater females, and it was insufficient in only 16.6 per cent of cases. That is, more than one-third of all contact information given by males about females is of little value for case finding, compared to less than one-fifth of similar information reported by females for their male companions.

These studies in sex differentials as between non-repeater and repeater patients demonstrate the importance of the infected and undiagnosed female and point out the necessity for increased case-finding efforts among females in our attempt to alter the present abnormal sex ratio and presumably halt transmission of the disease. The fact that the sex differential for the repeater group approaches closer to the epidemiological ideal suggests that further study of the transmission factors within this group and of the considerations outlined above might prove helpful in devising measures to improve our case-finding among females generally.

TABLE IV

ACTIVITIES OF THE VANCOUVER GAOL EXAMINATION CENTRE

FEMALES

1947–1954

	1947 (8 mos. May-Dec.)		1948		1949		1950	
Number Examined	471		1091		963		903	
Number Contacts	24	5.1%	96	8.8%	94	9.8%	94	10.4%
Number with New V.D.	106	22.5%	155	14.2%	135	14.0%	149	16.5%
New Syphillis	39		31		5		6	
New Gonorrhoea	67		124		130		143	
Gonorrhoea Treated on Epidemiological Grounds	0		0		0		0	

	1951		1952		1953		1954 (3 mos. Jan.-Mar.)	
	901		962		868		211	
	115	12.8%	104	10.8%	127	14.6%	40	18.9%
	168	18.6%	122	12.7%	76	8.7%	20	9.4%
	5		0		2		0	
	163		122		74		20	
	87		61		97		39	

Further light has been shed upon the problem of the female reservoir in venereal disease control by studies made in the clinic operated by this Division at the Vancouver City Gaol. Women attending this clinic are for the most part those under investigation, or who have been apprehended by the police and are being held pending a court hearing. Routinely they are checked for evidence of venereal disease by a skilled nurse-epidemiologist attached to the Division. All have a blood test, and urethral and cervical smears and cultures are taken to be examined for evidence of gonococcal infection. Many are syphilis patients under long-term follow-up by this Division, and, even more significantly, it has been our experience that many women being sought by us as named contacts, turn up there. Indeed, this has practically become a branch clinic specializing in female patients, for we have found that over 70 per cent of our Vancouver Clinic female repeaters regularly attend this gaol clinic.

A résumé of the activities of this gaol centre, from its inception in May of 1947 to the end of March, 1954, is given in Table IV and summarized in Figure 2.

It will be noted that, although the number of females examined at this clinic has remained relatively constant over the seven years of its operation, that percentage of the patient load comprising those previously named as contacts has risen steadily, while the percentage with new infections has shown a corresponding decrease, contrary to what might have been expected. One can only conclude that the reservoir of female gonorrhoea is shrinking despite the continuance of promiscuous activities in this group of patients. We believe that these figures accurately reflect the prevalence of venereal infections in the highly promiscuous female in the Vancouver area. The fact that

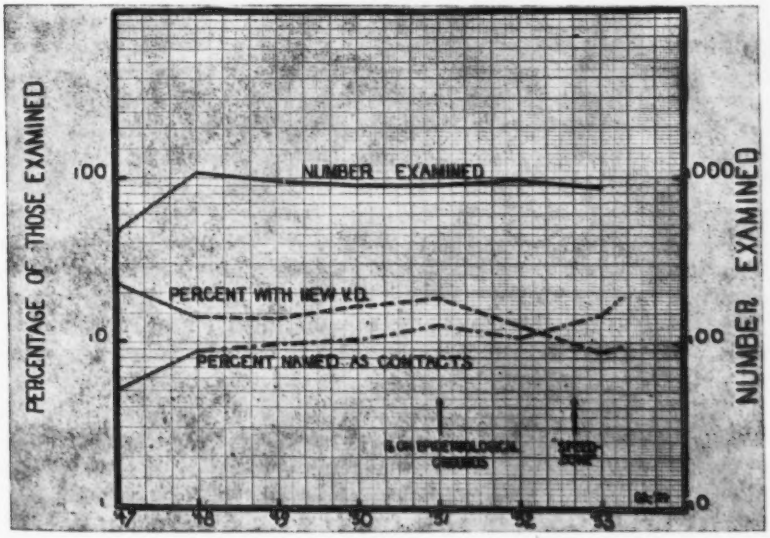

FIG. 2

ACTIVITIES OF THE VANCOUVER GAOL CENTRE

approximately 10 per cent of the females in this group still show evidence of infection indicates the sizeable reservoir that remains to be eliminated.

Having shown the importance of the undiagnosed female and also the sizeable female reservoir of infection which remains, let us now turn to consider some important epidemiological differences between gonococcal infections in the male and female (Table V).

TABLE V

SOME EPIDEMIOLOGICAL DIFFERENCES BETWEEN GONORRHOEA INFECTIONS IN THE MALE AND FEMALE

Clinical Observations	*Male*	*Female*
Reported Case Ratio	2.38	1.0
Incubation Period	3–5 days*	3–5 days
Symptoms	Obvious	Some, all or none
Bacteriological Diagnosis	Simple	Difficult
Motivation for Treatment	Great	Poor
Further Observations from Repeater Study†		
Reported Case Ratio	1.50	1.0
Frequency of Exposure	3–4/week	Unknown
Average number of infections during clinic history	3.19	6.37
Frequency of Infections	Every 420 days	Every 260 days
Details re Contact	Fair	Good
Source of Infection	Usually known	Rarely known
Occupation	Unrelated to Facilitation	40% known prostitutes
Summary		
	No diagnostic problem	Reservoir Undiagnosed female probably functions as *carrier* for indefinite periods
Value of Tracing Contact	Great	Little

References:

*Mahoney, Van Slyke et al., Am. J. Syph. Gonor., and Ven. Dis., 30: 1–39, 1946.
†Vancouver Clinic, 1951–1953.

The clinical observations outlined above are those familiar to all venereologists. They represent the problem of gonorrhoea as seen in clinical practice—the male reporting more often than the female, who has little motivation to seek treatment and who also presents a problem in bacteriological diagnosis. The honest clinician recognizes that unless he has a good epidemiological service attached to his clinic, he will see few new female infections.

In order to enlarge further upon significant epidemiological differences between gonorrhoea in the male and female, some pertinent observations gleaned from our repeater study have been added to the table. These would appear to merit some attention, remembering always that approximately one-third of all patients will have a repeat infection, usually within one year.

Thus, our studies have shown that the average male Vancouver Clinic repeater-patient is almost twice as sexually active as Kinsey's total normal group (1), with heterosexual intercourse occurring at the rate of 3–4 exposures per week. Unfortunately we have not as yet been able to get frequency figures for the repeater female.

The average male Vancouver Clinic repeater-patient has 3.19 infections

during the entire time he is known to the Division, while his female counterpart has exactly twice as many infections. Further, the average time between male re-infections is 420 days, while that between female re-infections is 260 days.

We have already seen that the contact information supplied by repeater females about males is of much greater value to the epidemiologist than the information supplied by the males about females, although it must be recognized that the male, because of the short incubation period and his easy recognition of the onset of disease, is in a much better position than the female to recognize the *source* of his infection.

In addition, we have found that for female repeaters, the occupation was usually conducive to the acquisition of venereal disease. Of 35 repeater females studied at our clinic, we noted that 14, or 40 per cent, were actually employed as prostitutes, and were known to the police as such; on the contrary, of 51 non-repeater females studied at the same time (February 1 to July 31, 1953), only 5, or 9.8 per cent, were known prostitutes. This difference is of statistical significance.

These observations suggest that the male repeater is a sexually active individual, acquiring an infection rather infrequently, remembering or knowing little of his paramours, but in the key position of being able to identify the source of his infection because of the short incubation period of his disease. Since the incubation period of gonorrhoea usually lies between three and five days (and the experimental observations of Mahoney, van Slyke et al. (2) have confirmed that 85 per cent of male infections produce clinical symptoms within six days), the epidemiologist can use the male patient as a signpost pointing towards the infected female and will be able to identify her with a high degree of certainty if he limits his investigations to those female contacts within six days prior to the onset of the disease in his male patients. The female, on the other hand, who has already been shown to be something of a "dark horse", acquires almost twice as many infections in short order, probably as an occupational hazard. In consequence, she rarely knows the source of her infection, and for the reasons given above, rarely comes to treatment of her own accord. In these circumstances she probably functions as a carrier of the gonococcus for indefinite periods of time.

Thus, in summary, a successful epidemiological attack on the present reservoir of infection must be based upon the recognition that the latter is mainly female and largely unidentified, and the appreciation that the objective of our epidemiology must be to prevent the infected female from disseminating her infection to a third party. In essence, this means that the undiagnosed female must be identified through her recent male contact and brought to treatment within a matter of hours, if the epidemiologic program is to achieve its best results and produce any alteration in the present abnormal sex ratio.

Such a focal attack has been incorporated in a four-point "speed-zone" program already instituted in this Division (Table VI).

(1) Intensive interviewing is carried out upon all males for information regarding their female contacts during the six-day period prior to the onset of symptoms. Since it is known that the male repeater is being exposed about 3–4 times a week, it is reasonable to suppose that at least 2–3 contacts should

TABLE VI

GONORRHOEA "SPEED-ZONE" PROJECT
4-POINT PROGRAM

(1) Increase the contact index by interviewing *all* male cases for female contacts.
(i.e., increase C.I.(M) to 1 plus).
(2) Locate named female contacts within 24–48 hours.
(i.e., before a 3rd party becomes infected).
(3) Treat female contact immediately.
(i.e., on epidemiological grounds).
(4) Control facilitation process.

be obtained from the interview. The exposure habits of non-repeaters are known only from Kinsey's data, but there seems little reason to doubt that the greater the number of contacts obtained from such individuals, the greater is the chance of finding the source of infection. As part of this intensive interviewing, immediate checking is done of all contact information obtained, such as telephone numbers, addresses, etc., since, as we have shown, this material is apt to be notoriously inaccurate when reported by chronic repeaters.

The contact interview can only be considered successful if more than one *identifiable* female contact is obtained from each male case.

(2) An attempt is then made to locate all identifiable female contacts within the next 24–48 hours in order to minimize the dissemination of infection. In this connection, it is extremely useful to know not only the contact index and the actual number of contacts investigated, but also the time which has elapsed before the contact is brought in for examination and treatment. Indeed, the success or failure of the epidemiological progam must be gauged by the rapidity with which possibly infected females are brought to treatment.

(3) When the suspected female is apprehended, she is treated immediately upon epidemiological grounds as a suspect carrier, although cervical and urethral smears and cultures are also taken to determine if a bacteriological diagnosis can be made. By this means we can reasonably expect to prevent infection or re-infection of the male at least temporarily despite any continuation of the female's promiscuous activities.

(4) Attempts to control the facilitation process are, in our opinion, just as important in an epidemiological program of this nature as they were formerly. It has been our experience that well over half of all exposures in both the repeater and non-repeater groups in the city of Vancouver occur in downtown hotels and rooms. We have attempted to control the facilitation process through premises of this nature by meetings with the proprietors and managers of the premises most frequently named by our patients, in an attempt to secure their cooperation in this phase of the control program.

A preliminary evaluation of the results obtained from the Vancouver Clinic "speed zone" program during the period August, 1953 to January, 1954 is given in Table VII.

Although this epidemiologic program has been in operation in the Vancouver Clinic area for little more than six months, the preliminary results obtained are encouraging. It has been particularly gratifying to note the increased percentage of female contacts who have been located and brought to treatment, an increase that is of statistical significance. In this connection it seems likely that the more selective pattern of patient-interviewing, with concen-

TABLE VII

VANCOUVER CLINIC—GONORRHOEA "SPEED-ZONE" PROJECT

	Control Period (Aug. 1952–Jan. 1953)		Speed-Zone Project (Aug. 1953–Jan. 1954)	
Number of Male Patients Interviewed		437		415
Female Contacts Obtained	486		456	
Contact Index (M)		1.11		1.10
Results of Investigation:				
Number of Female Contacts Investigated		414		388
Brought to Treatment	242		267	
Not Located	68		47	
Out of City Investigation	104		74	
		414		388
Contacts Located in Vancouver and Brought to Treatment (per cent)		(78%)		(85%)
Time to Bring to Treatment:				
Under 24 hours		125 (52%)		134 (50%)
Under 72 hours		158 (65%)		186 (70%)

tration of case-finding effort upon the most likely source of infection, has yielded dividends. Although the percentage of female contacts brought to treatment within 24 hours has remained virtually constant under the "speed zone" project as compared with the control period, the fact that an increased percentage has been located within 72 hours suggests that this is another step in the proper direction. With the acquisition of new attitudes and more skilful techniques in interviewing patients and tracing contacts, it does not seem unreasonable to believe that even better results could be obtained.

It would seem that more recognition will have to be given to the role of the private physician in a program of this nature. Since *forty-two per cent* of all V.D. patients in British Columbia in 1953 were first seen by the private physician, who reported them in the proportion of 3.08 males for each female, compared to the Division Clinics who reported 2.01 males per female, it is obvious that the private physician also sees relatively more males than females infected with V.D. Since the four-point program depends upon intensive interviewing of patients by the agency which diagnoses the infection, it is imperative that the full cooperation of the private physician be enlisted. This can only be secured by educational efforts directed towards bringing to his attention the importance of the undiagnosed female, and by helping him to acquire new attitudes and skills in interviewing for contacts.

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Results of Whooping-Cough Vaccination

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EIGHT years ago, a report was given before the members of this Association on a three-year experiment with combined diphtheria toxoid—pertussis vaccine. It was felt at the time that whooping-cough vaccine had a definite protective value and it was decided to extend vaccination to the whole population of this Province.

In the years that have passed, we have experienced two provincial epidemics of whooping-cough. Our intention is to place facts before you and let you reach your own decision.

During these years, the average number of live births has been around 125,000 annually, the average number of vaccinated children 76,397, and the average number of booster doses 75,568. Thus one may say that roughly a little over 60% of the infants are receiving whooping-cough vaccine and recall doses from year to year. This proportion is too small and should be increased.

Vaccination consists of four injections beginning at three months of age. The first dose is ½ c.c. Second and third doses of 1 c.c. are given at a monthly interval, followed by a fourth dose of ½ c.c. given from three to twelve months after the third. This fourth injection is not a booster dose and is considered necessary for a complete vaccination. Recall doses are offered when an epidemic occurs and when the child enters school for the first year.

TABLE I

NUMBER OF VACCINATED CHILDREN AND RECALL DOSES, QUEBEC, 1947–1953

Year	Number	Recall doses
1947	86,905	51,875
1948	76,503	61,261
1949	72,309	70,419
1950	69,711	76,890
1951	69,541	80,382
1952	76,037	88,186
1953	83,773	99,967

The morbidity rates from whooping-cough, 1934 to 1953, are given in Graph 1.

Before 1946, we used to have a province-wide epidemic every three years, with a peak of 250 cases per 100,000 and minimum rates of around 150. We have had two epidemics since then. The interval between the epidemics has

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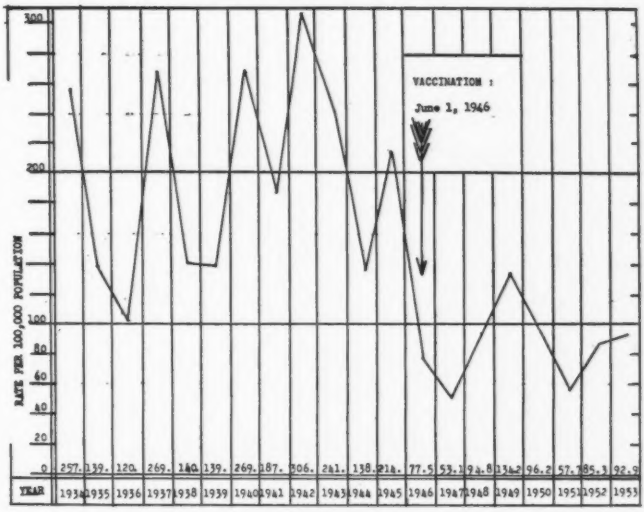

CHART 1

MORBIDITY RATES FROM WHOOPING COUGH
PROVINCE OF QUEBEC, 1934–1953

been increased to four years, and the highest peak, after vaccination, is of the same order as the lowest incidence in the pre-vaccination years.

One may feel that cases may not be reported as faithfully as they were before 1946. It may be said that we would like to see more complete reports; but one thing is sure: more attention is now given to this disease and its reporting is certainly much better than it was.

We do not think either that the use of antibiotics is the explanation of this decrease. We want to believe that the treatment of cases with chloromycetin and streptomycin may have decreased the number of deaths, but it could not have much influence on the number of cases.

The mortality rates from whooping-cough, 1934 to 1953, are given in Graph 2. One may say that there has been a notable decrease in the rates since 1946. As mortality follows morbidity, this graph could practically be superimposed on Graph 1.

Study of the Status of Vaccination

During the year 1953, 3,869 cases of whooping-cough were reported. We have seen that about 60% of the children are being vaccinated each year. A sample of 327 cases occurring in eleven county health units, scattered all over the Province, has been taken to find out the proportion of vaccinated children among the whooping-cough victims.

Out of the 327 patients, 160 (48.9%) had not been vaccinated; 115 (35.2%) had been vaccinated; and in 52 (15.9%) the status of immunity was unknown.

During the same year, 1953, 66 deaths, were caused by whooping-cough. Their age distribution is shown in Graph 3.

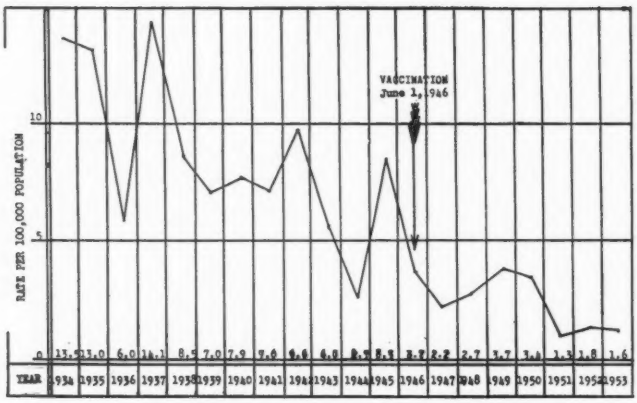

CHART 2

MORTALITY RATES FROM WHOOPING COUGH
PROVINCE OF QUEBEC, 1934–1953

Thirty of the 66 deaths occurred before six months of age. As vaccination begins at three months of age, none of these patients could be expected to have been vaccinated.

The 66 deaths were investigated to find out whether or not the child had received whooping-cough vaccine. In 61 cases it was definitely established that the child had not received the vaccine. One child had received the first two doses, one child had received two doses of ½ c.c. each, and one child had received three doses in 1950; in the remaining two deaths, the families could not be located.

The deaths that occurred were in the unvaccinated children. We do not know of a single death in a fully vaccinated child.

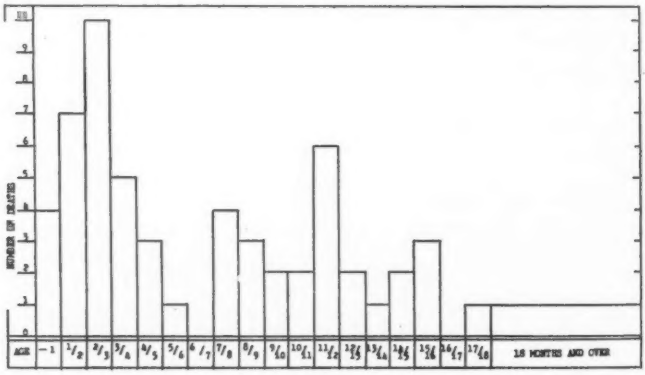

CHART 3

DISTRIBUTION OF DEATHS FROM WHOOPING COUGH
PROVINCE OF QUEBEC, 1953, BY MONTH OF AGE
AT DEATH

Summary

In summary, the following facts are presented for your consideration.

1. Around 60% of the children in this Province receive whooping-cough vaccine.

2. Since 1946, there has been a notable decrease in the prevalence of whooping-cough.

3. A remarkable decrease in mortality has also been observed.

4. Children who have received the vaccine may develop whooping-cough.

5. Children who have received the vaccine and contracted whooping-cough could, however, escape a fatal termination of the disease.

Typing of Eighty-eight Canadian Strains of Poliomyelitis Virus by Tissue Culture Methods*

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THE work of Burnet and MacNamara (1) first suggested that poliomyelitis virus existed in the form of different antigenic strains. The later studies of Bodian, Morgan, and Howe (2) and of Kessel and Pait (10) showed that there were three main types of virus, now known as Type 1 (Brunhilde), Type 2 (Lansing), and Type 3 (Leon). Subsequently, under the auspices of the National Foundation for Infantile Paralysis, a co-operative typing program was undertaken, whereby several investigators in the United States examined 230 strains (3, 20). Some 196 of these strains were allocated to the three types as follows: Type 1, 161 strains (82.1%); Type 2, 20 strains (10.2%); Type 3, 15 strains (7.7%).

Since the introduction of the tissue-culture technique by Enders, Weller, and Robbins (7), it has become possible to type strains of poliomyelitis virus more economically and with a greater degree of precision. By the tissue-culture method, allocation to antigenic types is made by neutralization tests with type-specific monkey antisera. Several investigators have now reported on the results of typing locally-isolated strains of virus, and various techniques have been found suitable. Thus, roller tube cultures of human embryonic tissue have been employed (13,18); other laboratories have found it more convenient to use monkey testicular or kidney tissue fragments in roller cultures (6, 12, 24). The Minneapolis group has introduced a strain (HeLa) of human malignant epithelial cells, which can be propagated readily in the laboratory (14, 15). The technique whereby monkey kidney tissue is dispersed with trypsin, so that "monolayer" cultures of epithelium develop (4, 23), is particularly well suited to use in typing studies.

The purpose of this paper is to present the results of typing 72 strains of poliomyelitis virus isolated by tissue-culture methods from cases of poliomyelitis in Canada in 1952 and 1953. Some of these results have been reported in brief previously (5, 6). The types of 16 additional Canadian strains isolated by our group in previous years are also given (22).

Methods

Our method of isolating poliomyelitis virus from faecal specimens, by the primary inoculation of "suspended cell cultures" with subculture into roller

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tube cultures, has been described in some detail (11), so need be mentioned only briefly.

Collection of Stool Specimens

The specimens examined were obtained partly from patients in this Hospital and partly from patients in different parts of Canada. The clinical diagnosis in all cases was "poliomyelitis", and usually "paralytic poliomyelitis".

Preparation of Stools for Inoculation

A 10% suspension of stool in saline, clarified by centrifugation at 3,000 r.p.m. for 20 minutes, was centrifuged in a refrigerated "Spinco" high-speed centrifuge for 1 hour at 40,000 r.p.m. The ultracentrifuged deposit was resuspended in a small amount of saline, and 1,000 units of penicillin and 1,000 micrograms of streptomycin were added per ml. This ultracentrifuged deposit, without further treatment, served as the inoculum for tissue cultures.

Tissue Culture Techniques

Flask cultures were prepared in 25-ml Erlenmeyer flasks with finely minced monkey kidney tissue suspended in Synthetic Medium 199 of Morgan, Morton, and Parker, with the addition of 500 units of penicillin and 250 micrograms of streptomycin per ml. A small number of cultures, at the beginning of this investigation, were prepared with minced monkey testicular tissue.

Roller tube cultures were prepared with fragments of monkey testis embedded in a clot of chicken plasma. To ensure a more abundant "outgrowth" of fibroblasts from monkey testicular fragments, 0.5 to 5% of horse serum was added to Medium 199.

Isolation of Virus from Stools

Two flask cultures of monkey kidney tissue were inoculated with a quantity of 0.1 ml of suspension of ultracentrifuged deposit prepared from stool. These cultures were kept for four weeks, and the supernatant fluids were replaced by fresh nutrient twice weekly. The fluids removed on the second and on the final occasion were subinoculated in groups of five roller tube cultures. When cytopathogenic changes were noted, the culture fluids were removed and subinoculated into a second group of five roller cultures, in order to passage the agent present. When cytopathogenic changes were observed in the second set of cultures, the fluids were removed, pooled, and stored frozen. These pools constituted the source of virus for the typing tests with antisera. If no cytopathogenic changes were noted in the various roller cultures inoculated with the fluid changes from the flask cultures, two further passages in roller cultures were made before the result was finally recorded as negative.

Typing of Cytopathogenic Agents

Virus pools from roller tubes showing cytopathogenic changes were diluted 1:2; appropriate quantities were mixed with equal volumes of normal monkey serum diluted 1:10, and with monkey antisera to Types 1, 2, and 3 poliomyelitis viruses (all diluted 1:10). The 50% neutralizing titres of the immune sera were in the range $10^{-4.5}$ to $10^{-5.5}$. Thus 1,000 to 10,000 50% neutralizing

doses of serum were used. After the virus-serum mixtures had stood at room temperature for 1½ hours, they were inoculated in groups of five roller cultures. The type of the virus under study was indicated by the inhibition of the cytopathogenic effect in the presence of only one of the three type-specific antisera.

A number of agents were isolated which were not inhibited by any of the three sera. To exclude the possibility that the titres of these agents were unusually high, titrations were carried out in tissue cultures. The 50% cytopathogenic doses (CPD_{50}) were as follows: agent 1, $10^{-4.7}$; agent 2, $10^{-6.3}$; agent 3, $10^{-3.8}$; agent 4, $10^{-3.3}$; agent 5, $10^{-4.9}$; agent 6, $10^{-3.2}$; agent 7, $10^{-3.0}$; agent 8, $10^{-3.7}$; agent 9, $10^{-5.1}$; and agent 10, $10^{-3.6}$. Typing tests were repeated on the seven agents with 50% cytopathogenic titres over $10^{-3.5}$, using 100 CPD_{50} of each agent. In order to study further the biological properties of these untyped agents, monkeys, adult mice, and suckling mice were inoculated.

pH Changes in Flasks

Enders noted that the pH of suspended cell cultures containing poliomyelitis virus did not fall as far as that of cultures from which no virus was recovered. Presumably, this effect is caused by destruction of tissue by virus with a consequent decrease in metabolism. Our results have been in complete agreement with the observations of Enders and his colleagues. In general, a pH differential was noticeable about two weeks after the cultures were infected with virus. All flask cultures from which a cytopathogenic agent was recovered, showed a higher pH than the uninoculated control cultures. However, certain of the cultures from which no agent was recovered showed a similar pH. One may conclude that failure of the pH to fall is indicative of the presence of a cytopathogenic agent, but this effect is not specific.

Results

It will be seen from Table I that from the stools of 80 patients ill with paralytic poliomyelitis in 1952 or 1953, 68 strains of poliomyelitis virus were isolated (Type 1, 63 strains; Type 3, 5 strains); in addition, 3 unidentified cytopathogenic agents were isolated. The recovery rate of poliomyelitis virus from stool specimens was therefore 85.0% (68/80). In previous studies by our

TABLE I

Typing in Tissue Culture of Strains of Poliomyelitis Virus from Stools of Cases of Poliomyelitis, Canada, 1952–1953: Distribution According to Type of Illness

Type of Illness	Total Number of Stool Specimens	Number of Specimens Yielding Poliomyelitis Virus			Percentage of Stools Positive for Poliomyelitis	Number of Specimens Yielding Unidentified Agent
		Type	Type 2	Type 3		
Paralytic	80	63	0	5	85.0%	3
Non-paralytic	35	4	0	0	11.5%	7
Total	115	67	0	5		10

group in which ultracentrifuged stool extracts were inoculated thalamically in rhesus monkeys, 28/30 (90.3%) positive results were recorded. It would appear that the sensitivity of the tissue culture technique is equal to that of monkeys.

Table I also shows that from the stools of 35 non-paralytic patients only 4 poliomyelitis viruses were recovered (all Type 1). An additional 7 unidentified cytopathogenic agents were isolated.

None of the 10 unidentified strains was pathogenic for monkeys, adult mice, or suckling mice.

Table II presents the results broken down according to year and geographic location. The strains isolated from the seven Provinces and Territories concerned were overwhelmingly Type 1, but in 1952 in British Columbia both Type 1 and Type 3 were recovered, as was the case in Toronto in the same year. It is of interest that the Type 3 strains from British Columbia were isolated from the Kimberley area, and the Type 1 strains from Vancouver. The two Toronto children from whom Type 3 virus was recovered were subsequently found to have been close contacts.

Discussion

A survey of the available literature, summarized in Table III, shows that 814 strains of poliomyelitis virus have now been typed by various authors either by monkey inoculation or by inoculation of tissue cultures. The source material for these studies included human pathological specimens and monkey central nervous system. The distribution into types is as follows: Type 1, 641 (78.8%); Type 2, 52 (6.4%); Type 3, 120 (14.7%); mixtures of two types, 1 (0.1%).

The distribution of the 88 strains isolated in Canada from 1948 to 1953 is as follows: Type 1, 80 (90.9%); Type 2, 2 (2.3%); Type 3, 6 (6.8%).

Summary

1. Poliomyelitis viruses were isolated from the stools of 68 paralytic and 4 non-paralytic patients from various parts of Canada in 1952 and 1953, by inoculation of suspended cell and roller cultures of monkey testis and kidney.

2. These 72 strains were typed in roller cultures with the following result: Type 1, 67 (93.0%); Type 2, nil; Type 3, 5 (7%).

3. Some 88 Canadian strains of poliomyelitis virus, 1948–1953, have now been typed by tissue culture methods, with the following results: Type 1, 80 (90.9%); Type 2, 2 (2.3%); Type 3, 6 (6.8%).

4. In addition, ten cytopathogenic agents were isolated which could not be typed by the techniques described, and which were non-pathogenic for monkeys and adult or suckling mice. Seven of these agents were recovered from non-paralytic and three from paralytic cases of poliomyelitis.

5. The reports of workers in various parts of the world who have typed poliomyelitis viruses are summarized. Some 814 strains have been allocated to types as follows: Type 1, 641 (78.8%); Type 2, 52 (6.4%); Type 3, 120 (14.7%); mixtures of two types, 1 (0.1%).

TABLE II

TYPING IN TISSUE CULTURE OF STRAINS OF POLIOMYELITIS VIRUS FROM STOOLS OF CASES OF POLIOMYELITIS, CANADA, 1952–1953: GEOGRAPHIC DISTRIBUTION OF TYPES

Year Specimens Collected	Tissue Culture Technique		Location of Patient		Type of Illness*	No. of Specimens Yielding Poliomyelitis Virus			No. of Specimens Yielding Unidentified Agent
	Flask Cultures	Roller Cultures	Province	City or Town		Type 1	Type 2	Type 3	
1952	Monkey testis	Monkey testis	Ont.	Toronto	NP	3	0	0	7
					P	4	0	2	1
	Monkey kidney	Monkey testis	Sask.	Saskatoon	P	3	0	0	0
			B.C.	Vancouver	P	1	0	0	2
				Kimberley	P	0	0	3	0
1953	Monkey kidney	Monkey testis	Yukon	Dawson	P	2	0	0	0
				Whitehorse	P	3	0	0	0
			Man.	Winnipeg	P	9	0	0	0
				Camp Shilo	P	1	0	0	0
				Vista	P	1	0	0	0
				Brulelles	P	1	0	0	0
				Eriksdale	P	1	0	0	0
			Ont.	Toronto	NP	1	0	0	0
				Toronto	P	18	0	0	0
				Orangeville	P	1	0	0	0
				Hepworth	P	1	0	0	0
				Barrie	P	8	0	0	0
				Mattawa	P	1	0	0	0
				Niagara Falls	P	3	0	0	0
			N.S.	Debert	P	1	0	0	0
			Nfld.	Northern Bay	P	1	0	0	0
				Western Bay	P	1	0	0	0
				Botwood	P	1	0	0	0
				Lewisporte	P	1	0	0	0
Total						67	0	5	10

*NP = Non-paralytic illness.
P = Paralytic illness.

TABLE III
RECORDED TYPES OF POLIOMYELITIS VIRUS, 1946–1953

Author	Geographic Location	Years of Isolation	Technique Used	Strains Studied	Allocation of Poliomyelitis Virus			
					Type 1	Type 2	Type 3	2 Types
Committee on Typing (3) Wenner (20)	Mainly North America	1909–1951	Monkey inoculation	196	161	20	15	
Verlinde et al. (17)	Northern Europe	1949–1952		25	17	7	1	
Wood et al. (21)	Northwest Territories, Canada	1949		3	3	0	0	
Gear et al. (8)	South Africa	1951	Monkey and mouse inoculation	1	0	1	0	
Thayer (16)	Australia	1951	Stationary cultures of monkey testis	18	15	0	2	1
Goffe (9)	England	1951–1952	Roller tube cultures of monkey testis	9	4	0	5	
Riordan et al. (12)	Germany; Connecticut, Pennsylvania (U.S.A.)	1946–1951		21	17	1	3	
Youngner et al. (24)	Pennsylvania (U.S.A.)	1949–1951		37	28	0	9	
Syverton et al. (15)	Minnesota (U.S.A.)	1946–1953	Stationary cultures of HeLa cells	300	247	10	43	
Weller (18) Robbins and Weller (19)	Massachusetts (U.S.A.)	1949–1952	Cultures of human embryonic tissue	116	69	11	36	
Wood and Duncan (22)	Canada	1948–1950	Suspended and roller cultures of monkey testis or kidney	16	13	2	1	
Present Study		1952–1953		72	67	0	5	
Total				814	641	52	120	1

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HUMAN BOTULISM

ON December 14, 1895, at the Belgian village of Ellezelles, 34 members of a musical society refreshed themselves with raw salted ham, after performing at a funeral wake. Most of them fell ill 20 to 36 hours later, displaying a peculiar neuro-paralytic syndrome which resembled the sausage poisoning (*botulismus*) first described from Württemberg 160 years before, and the fish poisoning (*ichthyosismus*) long recognized in Russia. Three of the musicians died within a week, while 10 others came close to death. Milder illnesses were suffered by several who ate lesser amounts of the ham. The few who altogether escaped had eaten only ham fat or a minimal portion of the meat.

The ham, salted in customary fashion about 24 hours after slaughtering an apparently healthy pig 12 days previously, had lain at the bottom of the brine barrel. From the rancid remnant, and from the spleen of one of the dead victims, van Ermengem of Ghent isolated an anaerobic, spore-forming bacillus. Culture filtrates, injected into animals such as rabbits, guinea-pigs, cats, pigeons and monkeys, produced characteristic and often fatal paralyses. van Ermengem showed that the Ellezelles tragedy was due to a neuro-toxin released into the ham by this bacillus, and he also attributed the so-called sausage and fish poisonings to this agent. In a report of classic thoroughness and undisputed conclusions, he proposed that the micro-organism be named *Bacillus botulinus*.

van Ermengem's findings, amply confirmed by several European workers in the first decade of this century, were extended in the second and third decades by bacteriologists in the United States, notably Dickson, Meyer and their associates. The rapid development of industrial canning of vegetables and fruits in California soon demonstrated that botulogenic foods were not necessarily very proteinaceous. In fact, whereas European outbreaks, due mainly to hams, sausages or fish, have shown fatality rates ranging from 30 to 45 per cent in Russia, and an overall 15 per cent for Germany, down to the remarkably low 2 per cent claimed for over 1,000 cases in France during the 1940–44 occupation, the mortality in nearly 1,400 cases recorded to date in the United States and Canada (mainly caused by canned spinach, olives,

string beans, corn, asparagus, beets and pears) has been around 65 per cent. The particularly lethal potentialities of inadequately sterilized canned vegetables and fruits derive from their anaerobic circumstances, from their liability to relatively long storage before consumption, and from the readier diffusion of toxin promoted by their juices. Meyer and his co-workers, and through them the canning industries, were induced thereby to reinvestigate the epidemiology of the disease, the distribution of the causal agent in nature, the thermal resistance of botulinus spores, and the factors conducive to toxin formation. Among their many publications was the 1922 report of the Botulism Commission, sponsored by the United States Public Health Service, whose findings resulted in the canning industries of California becoming subject to strict public health regulations in 1925, almost exactly a century after Kerner's pioneer monographs had led to compulsory notification of sausage poisoning in southern Germany. Commercially canned produce was thus practically eliminated as a source of botulism in North America.

Notwithstanding this progress, the United States still suffers an average of 2 or 3 known outbreaks annually; and the recorded incidence is certainly not declining in Canada, as witness the tabulation in an article in a contemporary journal (Canad. Med. Assoc. J., 1954, *71*, 245). Before 1943, only two outbreaks had been reported in this country; but since then, 12 have been described by one author and his colleagues. As four of these occurrences were encountered first by other persons, and additional isolated instances may have been entirely overlooked, botulism is probably less rare in this country than the literature indicates.

The control of the disease obviously demands close co-operation between clinician, public health department, and bacteriologist. The clinician is chiefly responsible for establishing the diagnosis. The acute syndrome should be unmistakable; but there is excuse for failure to recognize milder degrees of botulism, as exemplified by a recent case in British Columbia, which came to light only through the patient's chance allusion to chickens having died after their feed was mixed with a rejected jar of home-bottled spinach. Her unobtrusive symptoms were difficulty in visual accommodation and in swallowing, abdominal discomfort and constipation, muscular weakness and marked lassitude. The greater familiarity of some physicians in Germany and France with ambulatory botulinic syndromes may accentuate the above-noted disparity in fatality rates on the two continents.

North American outbreaks are nowadays nearly all traceable to home-preserved foodstuffs, and hence are not preventable merely by strict enforcement of government regulations; but public health departments are still very much involved. For instance, the health educator and the nutritionist should together manage to issue more authoritative pamphlets on the merits of various home-canning and pickling methods than can be expected of the newspaper's kitchen columnists. In the field, the medical health officer, public health nurse and sanitary inspector could each make more opportunities for stressing the hazards of many traditional methods of home-preserving, and for extolling the advantages of the pressure cooker. Moreover, these intermediaries should not be content to reiterate that prolonged boiling may

kill botulinus spores, and that nevertheless a few minutes' thorough preheating of preserved foods will destroy any toxin already formed. For these facts, though still often unapprehended by the public, were substantiated in detail by bacteriologists a generation ago. Without needing to keep up with the vanguard of research, public health workers should at least feel on firm ground in warning against the prevalent assumption that acidic conserves are inimical to toxin production; in stressing the importance of prompt gutting and cold storage of fish before pickling or smoking, to minimize the risk of toxin formation in the muscles by bacilli migrating from the intestine after death; in urging the scrupulous preparation and early consumption of cream cheese, in view of this vehicle having been implicated in a botulism fatality; and in reminding both advertiser and housewife that such modern processes as dehydration and deep-freezing not only retain the flavour, colour and nutritional values of foodstuffs, but may also ensure the viability of accompanying botulinus spores.

The bacteriologist's role in this alliance is to devise and apply methods for identifying the microorganism involved, to elucidate the sources and mechanisms of intoxication, and to provide biological products for specific treatment and prophylaxis. On the whole, he seems to have played his part quite well in this country, considering the difficulties. Admittedly, it is a little disconcerting (or gratifying, depending on the viewpoint) that of 14 Canadian outbreaks, only 6 have been bacteriologically verified, all in British Columbia. Yet it is doubtful if a better percentage of recovery has obtained elsewhere; and after all, bacteriologists cannot accomplish much with the wrong specimens, still less with none. Again, when botulism strikes, doctors and relatives usually start an urgent and fruitless hunt for antitoxin, which may end in criticism of the laboratory worker in general, and of biological manufacturers in particular. Granted that sero-therapy has long been practised for botulism in Russia, and that in recent years a combination of antitoxin and toxoid therapy has been advocated in France, there is so far no convincing evidence that the lives of botulism victims have been saved, or the disease prevented, by timely administration of specific antitoxin or toxoid. But since theoretical arguments favouring these products are supported by laboratory animal experiments, they are now in course of preparation in Canada. Another acknowledged lack is a thorough, recent survey of the distribution of botulinus spores in our regional soils, to supplement the one completed over 30 years ago at the University of California.

Actually, the study of botulism has lured bacteriologists of many nations far beyond the bounds of co-operative ventures with clinicians and public health officials. Collaboration with the veterinarian, pharmacologist, chemist, and ancillary specialists, has also yielded remarkable results. The lapse of a quarter-century has brought added cogency to Meyer's comment that "botulism has little importance as a cause of death: the car accidents of one single day, or one summer's lightning, claim more victims than the botulism outbreaks of several years". But no other human disease of comparable rarity has led to such far-ranging researches into the ecology, antigenic constitution, immuno-chemistry and toxicology of its aetiological agents.

Only brief allusions can be made here to a few of the fascinating developments thus brought about, during that short span of human history between the dirges at Ellezelles and the current threnodies foretelling civilization's doom over the global air. van Ermengem's bacillus has proliferated into the *Clostridium botulinum* species, numbering at least 5 types. In certain circumstances, each type elaborates a toxin capable of paralyzing animals or man, apparently through blocking the release of acetylcholine at myoneural junctions. These toxins, two of which (types A and B) have been crystallized, rank among the most poisonous substances known.

Although the types are considered antigenically quite distinct, C and D may show some overlapping. The 5 types display different ranges of pathogenicity for various animal species, e.g. A and B may affect man, horses and chickens; C and D are associated with avian, equine and bovine outbreaks; while type E has so far been implicated only in human botulism. But these observations are not final: experiments on monkeys suggest, for instance, that type C-beta toxin could prove lethal to man. These C-beta organisms, whose prototype was isolated by Seddon in Australia, in 1922, are more widespread than was formerly realized. Well-known to veterinary bacteriologists in South Africa, they were recently identified (after some confusion) as the cause of equine botulism in Belgium and France; and a similar strain appears to have been isolated in California from human stomach contents at autopsy. Type E organisms, unrecognized before 1936, may be even more widely distributed, since they are known to have been isolated now from 14 human outbreaks in Japan (5), the United States (4), Canada (3), the Soviet Union (1), and Denmark (1). Moreover, the presence of type E organisms in local soil, water, or fish intestinal contents has been demonstrated in Japan, the Soviet Union, Denmark, Canada and France. Incidentally, before 1951, no botulism episode due to any type had ever been recognized in Japan.

To adduce further examples might obscure the primary purpose of these remarks, which was to outline a story of hopeful achievement and unfinished business in a rather specialized field of bacteriology and preventive medicine. A secondary objective was to illustrate, on a small scale, the kind of pathway which can and should be constructed internationally in mankind's quest for control of his material environment.

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